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Rubber Research Scheme

(Ceylon)

Combined Third and Fourth

Quarterly Circulars for 1939.

December, 1939.

Rubber Research Scheme (Ceylon)

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DARTONFIELD ESTATE—VISITORS' DAYS

The *second* and *fourth* Wednesdays in each month have been set aside as Visitors' Days at Dartonfield estate, and the services of technical officers will be available to visitors on those days. The estate superintendent will be available every Wednesday. Visitors are requested to arrive on the estate not later than 9.30 a.m.

While visitors will be welcomed at the Station on other days, any particular member of the staff may not be free to give them attention unless an appointment has been made.

Dartonfield estate is situated about $3\frac{1}{2}$ miles from the main Matugama-Agalawatta Road, the turn-off being near culvert No. 14/10. The distance from Colombo is approximately 47 miles.

PUBLICATIONS

Rubber Research Scheme publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Leaflets are available without charge to the Proprietors (resident in Ceylon, Superintendents and Local Agents of Rubber estates in Ceylon) over 10 acres in extent. Application for registration should be made to the Director, stating the name, acreage, and registered number of the estate(s) concerned.

MEMORANDA ON PLANTING TOPICS

Typescript copies of the following memoranda may be obtained on application :—

1—Notes on budgrafting procedure (Revised March, 1939).

2—Programme of manuring for replanted Rubber clearings (Revised June, 1939).

3—Notes on Rubber seedling nurseries (Revised November, 1939).

4—Contour lining, holing and filling, cutting of platforms, trenches and drains (Revised June, 1939).

5—Straining box for latex (March, 1939).

6—Notes on the care of budded trees of clone Tjirandji 1 with special reference to wind damage (September, 1938).

7—Dartonfield Estate. Notes on factory procedure and equipment (Revised November, 1939).

8—Planting and after-care of budded stumps (May, 1939).

9—Preparation of latex for shipment (Revised August, 1939).

10—Root disease in replanted areas (August, 1939).

11—Emergency Rubber coagulants (December, 1939).

FIELD EXPERIMENTS ON DARTONFIELD ESTATE—X

MEASUREMENTS OF GROWTH IN REPLANTED AREAS, 1939

L. A. WHELAN, *Soil Chemist*
and
C. A. de Silva, *Assistant Botanist*

THIS paper gives an account of the growth measurements in the experimental areas on Dartonfield, and is the third in the series. Previous accounts of these measurements for 1937 and 1938 will be found in the issues of the Rubber Research Scheme, Quarterly Circular, Vol. 14, 1937, Parts 3 and 4, and Vol. 15, 1938, Part 3. For full details of the scope and design of these experiments, the reader is referred to the undermentioned issues of the Quarterly Circular :—

Vol. 11, 1934, Parts 3 and 4.
Vol. 13, 1936, Parts 2 and 3.
Vol. 13, 1936, Part 4.

A brief description of the experimental layout of each area is given for convenience, and precedes the discussion of results.

No. 1 Replanting Experiment, 1934 Clearing, 7½ Acres

The area is 7½ acres and is divided into three blocks planted respectively with clones Glenshiel 1, A.V.R.O.S. 256 and Prang Besar 25. Each block is divided into four strips running from top to bottom of the hillside planted respectively with the following ground covers :—

1. *Centrosema pubescens*
2. *Pueraria phaseoloides* (*P. javanica*)
3. *Calopogonium mucunoides*
4. *Dolichos Hosei* (*Vigna oligosperma*)

At right angles to these strips each block is divided into three plots with the following methods of dealing with the old timber :—

A. Leaving all large timber lying unburned.

B. Burning all timber *in situ*.

C. As B, but removing and burning all larger lateral roots.

The "plaid shawl" arrangement arising from these strips and plots at right angles to one another results in unit plots of 16 trees, and each plot is divided into two sub-plots, with different methods of controlling ground cover, as under :—

X Keeping individual platforms (15 feet long) clean weeded.

Y Ring weeding in 6 feet circles round each tree.

The field was replanted with budded stumps in June, 1934, but the stocks were not cut back till September, 1934. The annual girth measurements of trees have been taken in September, 1939, at five years old.

The mean girth measurements for the various treatments for four consecutive years are given in Table 1, together with the increments for 1938-39. A number of trees round the periphery have been excluded as boundary trees, and do not come into he figures of the experiment.

TABLE I

Budded Stumps Planted in June, 1938.

Budded Stumps Girth in Inches at 3 feet from Union

Treatment	1936 Age 2 yrs.	1937 Age 3 yrs.	1938 Age 4 yrs.	1939 Age 5 yrs.	Increase 1938-39
Species of Cover					
1. *Centrosema pubescens*	5·16	8·93	13·40	17·29	3·89
2. *Pueraria phaseoloides*	4·95	8·61	13·56	17·86	4·30
3. *Calopogonium mucunoides*	5·51	9·36	13·83	17·69	3·86
4. *Dolichos Hosei* (*Vigna*)	5·43	9·66	14·49	18·48	3·99
Mean	5·26	9·14	13·82	17·83	4·01
Standard error	—	0·19	0·18	—	0·087
Significant difference (P. = ·05) ...	Not significant	0·64	0·61	Not significant	0·30
Timber Treatments					
(*a*) Leaving all main stems lying unburned	5·38	9·38	14·06	18·08	4·02
(*b*) Burning all timber on the land ...	5·19	9·16	13·94	17·99	4·05
(*c*) as (*b*) but also removing and burning all larger lateral roots	5·22	8·88	13·46	17·42	3·96
Mean	5·26	9·14	13·82	17·83	4·01
Differences		Not significant			
Control of Cover—					
X Keeping platforms clean weeded ...	5·30	9·17	13·76	17·64	3·88
Y Ring weeding in 6 feet diameter circle ...	5·22	9·10	13·88	18·01	4·13
Mean	5·26	9·14	13·82	17·83	4·01
Differences		Not significant			

Table I also indicates the differences which can be considered significant according to the conventional standard of a 20 : 1 chance. The differences between the mean girth measurements, corresponding to species of cover, are not significant, but the mean increase of growth of 4.30 inches in 1938-39 in the Pueraria plots is significantly higher than that in other plots. This suggests that Pueraria, which apparently caused the biggest retardation to growth in the first three years on account of its luxuriant development, is now proving to be the most beneficial to the soil.

There is no significant difference between the growth of the trees on the ring weeded and clean weeded platforms, but the following extract from last year's report may be quoted :—

" These observations would be incomplete without stating that the cover has been taken back from the platforms in the Y sub-plots twice a year at the times of manuring. At one six-monthly application the cover has been mulched on the surface, while at the other it has been forked into the platform. Had this additional control not been exercised, it is possible that the trees on the clean weeded platforms would have shown superior growth to those which are only ring weeded."

The general rate of growth of 4.01 inches, although below the figure of 4.68 for the previous year, may be considered satisfactory.

The results of the timber treatments are again inconclusive, but the indication of poorer growth in areas where the lateral roots have been removed still persists.

Two cases of root disease have been reported during the experimental year, one a case of *Poria hypobrunnea*, and the other a case of *Fomes lignosus*. Altogether five cases of root disease have occurred in this clearing ; all in areas where the lateral roots were left in the ground. This suggests that the incidence of root disease can be materially reduced by preliminary removal of the larger lateral roots.

The mean girth measurements for the three clones are given in Table II.

TABLE II

Clone	1936	1937	1938	1939	Increase 1938-39
Glenshiel 1	5·09	8·54	13·04	16·94	3·90
A.V.R.O.S. 256	5·63	10·00	14·57	18·30	3·73
Prang Besar 25...	5·05	8·88	13·85	18·25	4·40
Mean	5·26	9·14	13·82	17·83	4·01

A comparison of these figures is not statistically valid, but it is interesting to note that Clone Glenshiel 1 shows a very fair rate of growth in a block which falls into a less favoured portion of the field.

General information on the growth of all trees in the experimental area is presented in the form of a histogram on facing page which illustrates the frequency distribution of the trees for 1939. The trees have been divided into classes according to girth, and the heights of the columns signify the number of trees within each class.

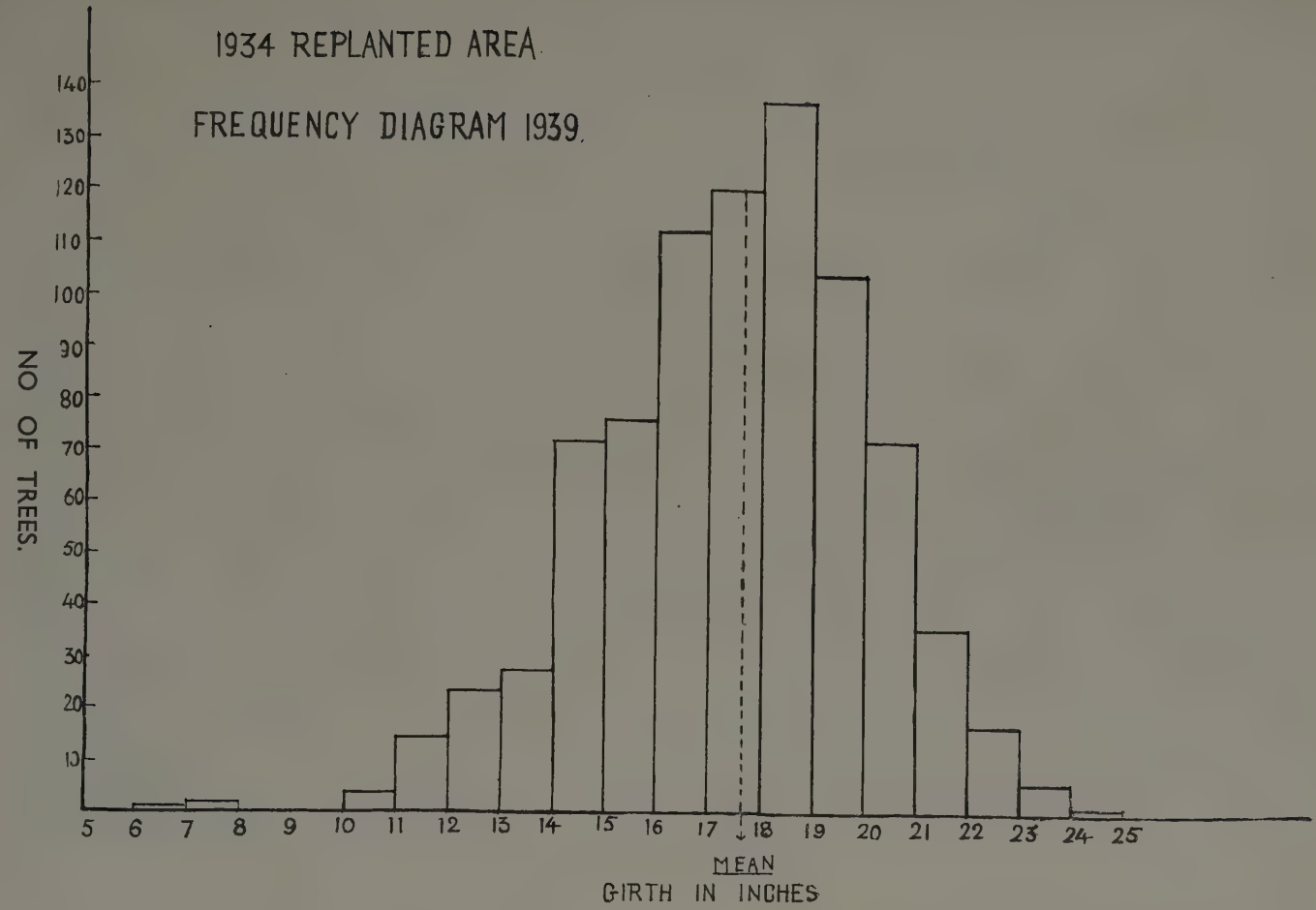
On the assumption of an increase of four inches for the next experimental year, approximately 90 per cent. of the trees will reach a girth of 18 inches in September, 1939, at six years old, and approximately 75 per cent. will become tappable in the same time, judged by a criterion of 20 inches as a tappable size. Seventeen per cent. of the trees are already of a tappable size.

No. 2 Replanting Experiment, 1938, 19½ Acres

This experiment now comprises two areas, one of 13 acres divided into four blocks and one of 6½ acres divided into two blocks. Replanting with budded stumps was carried out in May-June, 1938. Each block is divided into nine plots for a comparison of the manurial treatments N, P, K, NP, NK, PK, NPK, Compost and Control. Each plot contains 16 trees and additional plants serve as guard trees between the plots.

The manures applied per plant in the NPK plots up to the time of the last series of measurements were :

	Sulphate of Ammonia	Safaga Phosphate	Muriate of Potash
May, 1938	5·2 oz.	3·3 oz.	1·9 oz.
March, 1939...	2·4 oz.	1·7 oz.	1·0 oz.


1934 REPLANTED AREA.
FREQUENCY DIAGRAM 1939.
NO OF TREES.
140
130
120
110
100
90
80
70
60
50
40
30
20
10
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
MEAN
GIRTH IN INCHES

The amounts of artificials applied to the other plots were made up from the above quantities. In the compost plots an amount of compost obtained from the Kalutara U.D.C. was added equivalent in nitrogen content to the inorganic manure. When, as happened in 1938, the P and K values of this amount fall below those of the inorganic mixtures, the deficiencies are made good by the addition of the requisite amounts of rock phosphate and muriate of potash. For the March, 1939, application 4 lbs. 3 oz. of sieved U.D.C. compost, practically equivalent in N, P and K nutrient values to the inorganic NPK mixture were added per plant. The manures in 1938 were added to the planting hole and in 1939 were broadcast in a circle round the plant.

Measurements of height were taken in March, 1939, and of height and girth in September. As block 2 had to be replanted in November, 1938, figures for this block were not included in estimating the mean heights given in Table III.

TABLE III

Mean Height in Inches per Plant (Mean of 5 Blocks)

Treatment	March.		September		Increment March-September	
	Actual	Increase over O	Actual	Increase over O	Actual	Increase over O
O	43·6	—	108·8	—	65·2	—
N	47·1	3·5	108·3	—0·5	61·2	—4·0
P	46·6	3·0	116·7	7·9	70·1	4·9
K	44·2	0·6	110·3	1·5	66·1	0·9
NP	40·6	—3·0	104·9	—3·9	64·3	—0·9
NK	50·7	7·1	119·2	10·4	68·5	3·3
PK	46·3	2·7	125·4	16·6	79·1	13·9
NPK	53·8	9·2	132·0	23·2	78·2	13·0
Compost	51·5	7·9	131·1	22·3	79·6	14·4
Standard Error ...					4·1	
Significant Difference P=·05	Not significant		Not significant		11·8	

The March results show no significant differences among treatments, but there are indications that response has followed the application of NK, NPK and Compost. Significant results are still absent from the actual height measurements of September, but apparently PK, NPK and Compost have given the best results.

The increment figures for the six months indicate a significant increase over the control for the treatments PK, NPK and Compost.

If the general effect of each nutrient be examined (*e.g.* in the case of nitrogen, the mean of the responses to N alone, to N in presence of K, to N in the presence of P and to N in the presence of PK) the following values are obtained :—

N	—2·1 ins. not significant
P	7·7 ins. significant
K	7·7 ins. significant

Both P and K have significantly increased the height of plants in this clearing whilst there is no indication of a response to N. Two possible causes may explain the lack of response to nitrogen. Firstly, the greater part of the nitrogen applied at the time of planting may have been leached out of the soil before the budded stump could assimilate it. Secondly, the nitrogen level of this soil which at the time of replanting was carrying a vigorous cover crop may have been satisfactory without the application of additional nitrogen.

The failure to respond to nitrogen should not be taken as an indication that this element is generally unnecessary for young budded Rubber, but it does offer some justification for the delay of nitrogen manuring until about four months after planting except in cases where cyanamide may be added to assist in the breakdown of green material added to the planting hole.

The mean girths in inches per plant for the various treatments are given in the following table. The figures are the means of five blocks and as this is the first series of measurements increment values cannot be given.

TABLE IV

Treatment	O	N	P	K	NP	NK	PK	NPK	Compost
	2·81	2·93	2·96	2·87	2·71	3·10	3·05	3·25	3·29
Increase over O...	—	·12	·15	·06	—·10	·29	·24	·44	·48

The results are not significant, but there are indications of response to the NPK and Compost treatments.

A point of some importance results from a comparison of the figures for the treatments NP and NPK. The omission of K from the complete NPK mixture has resulted in a decrease in height of 13·9 ins., a result statistically significant. Indication of a similar result for girth measurements is also found, but this is not significant. This is of greater interest because of a similar finding (on a yield basis) for the manuring of old Rubber on the same estate.

Whilst this experiment indicates a significant response to a moderate application of a PK manure in the first 15 months after planting, it is not possible at this stage to forecast what the economic advantages of such manuring are likely to be, nor is it to be expected that response to the same manurial treatment would be obtained on every clearing.

No. 3 Replanting Experiment, 1936, 9½ Acres

This area is divided into four monoclonal blocks, planted with A.V.R.O.S. 49, Prang Besar 25, Sungei Reko 9 and Rubana 393. Each block is divided into three sub-blocks for a comparison of methods of opening :—

(1) Platforms
(2) Trenches
(3) Pitted Drains

Each sub-block is divided into three plots for a comparison of methods of planting—

(*a*) Planting budded stumps
(*b*) Planting stumped buddings
(*c*) Seed at stake for budding in the field

Finally each plot is divided into two sub-plots for a comparison of organic and inorganic fertilisers. Each sub-plot consists of a group of 12 plants.

The manures applied per plant in April, 1939, were :

Organic		*Inorganic*	
Blood Meal	11·2 oz.	Sulphate of Ammonia ...	7·1 oz.
Bone Meal	6·9 „	Safaga Phosphate ...	5·0 „
Muriate of Potash	1·4 „	Muriate of Potash ...	1·4 „

The above doses were given to plants budded in the nursery and half the above to plants budded in the field.

In June, 1939, girth measurements were taken of all plants in the area and a summary is given below.

TABLE V

Mean Girth in Inches per Plant

(*Combined Analysis for Budded Stumps, Stumped Buddings and Plants Budded in the Field*)

Methods of Opening		*Methods of Planting*		*Manuring*	
1. Platforms ...	8·99	1. Budded Stumps...	9·19	1. Organic ...	8·64
2. Trenches ...	8·87	2. Stumped Buddings	11·84	2. Inorganic ...	8·64
3. Pitted Drains ...	8·07	3. Budded in the Field	4·89		
Mean... ...	8·64		8·64		8·64
Standard Error ...	·198		·266		
Significant Difference (P = ·05) ...	·69		·79		

As 1938 measurements are not available for plants budded in the field the figures given in Table VI, which include growth increments for the year, refer to budded stumps and stumped buddings only.

TABLE VI

Mean Girth in Inches per Plant

(*Combined Analysis for Budded Stumps and Stumped Buddings*)

	1938	1939	Increment 1938-39
Methods of Opening—			
1. Platforms	7·61	10·84	3·23
2. Trenches	7·57	10·86	3·29
3. Pitted Drains	6·97	9·86	2·89
Mean	7·38	10·52	3·14
Standard Error	·146	·260	·174
Significant Difference (P = ·05)	·504	·900	Not ...significant
Methods of Planting.—			
1. Budded Stumps	6·21	9·19	2·98
2. Stumped Buddings	8·55	11·84	3·29
Mean	7·38	10·52	3·14
Standard Error		·299	·169
Significant Difference (P = ·05)	Not significant	·956	... Not significant
Manuring.—			
1. Organic	7·44	10·59	3·15
2. Inorganic	7·32	10·45	3·13
Mean	7·38	10·52	3·14
	Not significant	Not significant	Not significant

Methods of Opening.—The growth on the platforms and in the trenches is practically the same, but in both cases is significantly better than in areas where there are level silt pitted drains between the contour rows. The present difference of almost an inch in favour of the first two systems is substantial, but the trees are still too small to permit a definite preference to be given.

A similar conclusion is reached from an examination of the summary for only those plants budded in the nursery. In 1938 the platform and trench systems showed an increase of about 0·6 inch over the pitted drain, and in 1939 this difference had increased to 1 inch.

Methods of Planting.—The difference between stumped buddings and budded stumps mentioned in the third Quarterly Circular for

1938 has been maintained. The difference in 1938 was 2·35 inches in favour of stumped buddings and in 1939 this has increased to 2·65. Plants budded in the field are at this stage only a little more than half the size of the budded stumps. The increment values for the year (Table VI) show the same result although the differences are not statistically significant.

Manuring.—The difference between plants given an organic and those given an inorganic manure is slight and not significant. It should be pointed out that the comparison between organic and inorganic artificial manures includes the addition of green material to both treatments.

To-date there is no indication of a better response to organic manure than to the cheaper inorganic if the normal estate practice of incorporating green material be followed.

SUMMARY

1. Replanting experiments are briefly described and the results are summarised.

2. A significantly higher rate of growth of young budded rubber is found in areas planted with *Pueraria phaseoloides* than with other covers in the fifth year of growth.

3. The average growth of trees which are ring weeded is slightly better than that in clean weeded platforms, but the difference is not significant.

4. Differences in growth of trees corresponding to three timber treatments are found not significant, but indications of poorer growth are still evident in areas where lateral roots have been removed.

5. A study of the frequency distribution of all trees in the 7½ acre replanting experiment according to girth shows that approximately 75 per cent. of trees will become tappable at six years old.

6. The application of a PK artificial manure to budded rubber in the first year after planting has resulted in a significant increase in height.

7. Omission of potash from an NPK mixture has resulted in a significant decrease in height.

8. The girth of trees in their third year is significantly greater for the platform and trench systems of opening than for the pitted drain system.

9. For trees in their third year girth measurements of stumped buddings are significantly greater than those of budded stumps and budded stumps are greater than plants budded in the field.

10. A comparison of the growth response of young Rubber to organic and to inorganic manures has shown no difference between the two forms.

A STANDARD INTERNATIONAL NOTATION for SYSTEMS OF TAPPING HEVEA

(**Editor's Note.**—The standard notation announced in this article was devised by Mr. Evan Guest, of the Rubber Research Institute of Malaya, to provide a basis for describing tapping systems logically and accurately and to overcome misunderstandings arising from the fact that some of the symbols at present in common use have different meanings in different countries. The proposed notation was discussed with research officers in Java, Sumatra and Ceylon, and in its final form has been formally adopted by the research organisations in all four countries. The notation will be used for describing tapping systems in future Research Scheme publications and it is hoped that it will also be generally adopted by Planters).

The Standard Notation

IT is proposed to introduce a standard notation to describe tersely and explicitly the various systems of tapping rubber trees. The notation consists of a set of symbols which should be used in regular sequence to define respectively :

(1) the number of cuts tapped on each tree at each tapping,
(2) the length of each cut,
(3) the type of cut,
(4) the frequency of tapping

and, in periodic systems,

(5) the lengths of the periods of tapping and rest.

In addition, a figure denoting

(6) the relative intensity of the system

should accompany the standard symbols.

Special symbols are also provided for insertion when it is desired to indicate

(7) change-over systems of tapping.

(1) Number and (2) Length of Cuts

To be expressed in the form of a fraction :

(*a*) the numerator to denote the number of cuts tapped on each tree at each tapping,

and (*b*) the denominator to denote the horizontal length of each cut expressed as a fraction of a full circumference (that is : 2 for $\frac{1}{2}$ circumference, 4 for $\frac{1}{4}$, etc.).

Examples :

1/2, 1/3, 1/4 = *one cut on half, third or quarter circumference,*

1/1 = *one full circumference cut,*

2/2 *or* 2/4 = *two cuts, each on half* or quarter circumference*

and 4/2 = *four half-circumference cuts.*

(3) Type of Cut

Only two types of cut are common in use at the present day, the spiral and the V cut.

To be designated by the capital letters

S = spiral cut

and V = V cut.

Where the type of cut is unrecorded these symbols can be omitted without affecting the remainder of the notation. The type of cut may not be of great importance, but should generally be recorded.

(4) Frequency of Tapping

To be expressed in terms of the daily interval between tappings, thus (in small letters) :

d = daily,

a.d. or 2d = alternate-daily (= every second day),

3d = every third day,

4d = every fourth day,

and so on.

To describe possible systems with tappings two or more times daily, the symbols dd, ddd, etc., can be used, if required.

(5) Length of Periods of Tapping and Rest in Periodic Systems

To be expressed by two numbers denoting respectively the periods of continuous tapping (at the stated frequency) and of rest, followed by either the small letter

---

* Can also be written in full, if desired, as $\frac{1}{2} + \frac{1}{2}$ $(= \frac{1 + 1}{2} = 2/2)$.

For further refinements, see under " Some Amplifications " (p. 116).

d = days,
w = weeks,
or m = months
to indicate the unit in which the period is reckoned.

Examples :

20/20*d* = *twenty days' tapping followed by twenty days' rest,*
6/3*w* = *six weeks'* ,, ,, *three weeks' rest,*
12/4*m* = *twelve months'* ,, ,, *four months' rest*
8/2*m* = *eight* ,, ,, ,, *two months' rest*
3/1½*m* = *three* ,, ,, ,, *one-and-a-half months' rest.*

The former symbols A.B., A.B.C., etc., indicating the number of sections into which an area is sub-divided for periodic tapping, should be omitted. They can be deduced from the periods of tapping and rest. Thus, on the old Malayan notation, the above examples would represent A.B., A.B.C., A.B.C.D., A.B.C.D.E. and A.B.C. systems respectively. The reasons for abandoning these symbols are that they have been applied differently in Malaya, Ceylon and the N.E.I. : they are clumsy, redundant and ambiguous. Even as general terms they are better replaced by the more precise conception of intensity described below.

(6) Relative Intensity of Tapping

To be expressed as the percentage of the intensity on the ½a.d. system (reckoned over an equal tapping period and, in periodic systems, covering a full cycle of tapping and rest).

Tapping System	Percentage of area resting	Percentage of area in tapping	Percentage of trees tapped per day (=*column 3, divided by the "frequency"*)	Total length of cut per tree (*as fraction of circumference*)	Mean percentage of total circumference tapped per day (=*column 4 x column 5*)	Relative intensity (*expressed as percentage of ½a.d.*)
1	2	3	4	5	6	
1/2*S*,*a.d*	Nil	100	50	½	25·0	100
1/3*S*,*a.d.*	Nil	100	50	⅓	16·7	67
1/2*V*,3*d.*	Nil	100	33	½	16 7	67
1/4*S*,*a.d.*	Nil	100	50	¼	12·5	50
1/1*S*,4*d.*	Nil	100	25	1	25·0	100
1/2*S*,*a.d*,6/3*m*.... ...	33	67	33	½	16·7	67
2/2*V*,3*d*,3/3*m* ..	50	50	17	1	16·7	67
1/2*S*,*d*,20/20*d*.... ...	50	50	50	½	25 0	100

For tabulation with yield records *absolute* intensity is a more valuable index than relative. Absolute intensity can be reckoned as the product of the length of each cut and the total number of individual incisions (tappings), thus expressing the aggregate length of incision in full circumference units. In the standard notation, however, *relative* intensity is the better scale against which the severities of different tapping systems can be compared at a glance.

(7) Change-over Systems

To be designated by the insertion of special symbols *in brackets*.

Since these are systems of tapping commonly practised in Ceylon (and sometimes in the Netherlands East Indies), but not hitherto in Malaya, details of change-over symbols have been deferred to the special section on p. 116. Change-over systems are distinguished by a rhythmic alternation or rotation of tapping on successive panels at intervals of from one day to a year, in contrast to ordinary " straight " tapping on which each panel is completely tapped out before the cut is turned over to the next. Those not interested in the change-over notation may skip the final section of this article.

Some Examples of the Full Notation

The symbols explained above should always be used in the same sequence, thus :—

(1) 1/2V,a.d,100% = a half-V cut tapped alternate-daily.

(2) 1/3S,a.d,67% = a third-spiral cut tapped alternate-daily.

(3) 1/2S,a.d,12/6m,67% = a half-spiral cut tapped alternate-daily for twelve months, followed by six months' rest. (One of the common A.B.C. systems on the old notation in Malaya).

(4) 1/3S,d,40/20d,89% = a third-spiral cut tapped daily for forty days, followed by twenty days' rest. (Also an A.B.C. system on the old notation, but with daily instead of a.d. tapping and a shorter cut. Note the difference in intensities of examples (3) and (4), ignored on the old notation).

(5) 1/2S,3d,12/4m,50% = a half-spiral cut tapped every third day for twelve months, followed by four months' rest. (An A.B.C.D. system on the old Malayan notation).

(6) 2/2S,4d,100% = two half-spiral cuts tapped every fourth day. (The " Double Four " system).

(7) 2/2V,3d,5/5m,67% = two half-V cuts tapped every third day for five months, followed by five months' rest. (One of the " Sunderland " systems).

(8) 2/2V,3d,15/10w,80% = two half-V cuts tapped every third day for fifteen weeks, followed by ten weeks' rest. (A rather more intensive modification of the Sunderland system. On the old Malayan notation this could be described as an A.B.C.D.E. system with two out of the five sections always resting).

(9) 1/1S,3d,3/1m,100% = a full-spiral cut tapped every third day for three months, followed by one month's rest.

(10) 1/1V,4d,100% = a full-circumference extended-V cut tapped every fourth day.

(11) 1/2S,d,1/1m,12/6m,67% = a half-spiral cut tapped daily alternate-monthly for twelve months, followed by six months' rest. (A system sometimes used in Sumatra : showing how a periodic system within a periodic system can be symbolised on the standard notation).

(12) 4/2V,a.d,400% = four half-V cuts tapped alternate-daily. (An example of a system used in slaughter tapping).

Some Amplifications of the Notation

Sufficient examples are quoted above to show that the standard notation can cover all or nearly all the tapping systems in common use. For those who wish to extend it and discriminate between some of the more intricate variations of multiple-cut systems, further refinements can be devised. A simple convention is also proposed to distinguish the " change-over systems " of Ceylon from ordinary systems of continuous tapping.

Multiple-cut Systems

Where it is particularly desired to indicate the position of the cuts in a double-cut or multiple-cut system, the fractions denoting

individual cuts can be written in full, using the following conventional signs :

/ (stroke) = cuts in echelon on adjacent panels,
+ (plus) = cuts on opposite sides of the tree,
and — (minus) = cuts superimposed one above the other on the same panel.

Examples :

$\frac{1}{4}/\frac{1}{4}$ *S,a.d,*100% = *two quarter-spiral cuts in echelon tapped alternate-daily. (This could be simplified to* 2/4*S,a.d.*),

$\frac{1}{4}+\frac{1}{4}$*S,a.d,*100% = *two quarter-spiral cuts on opposite panels tapped alternate-daily. Also* = 2/4*S,a.d.*),

$\frac{1}{2}-\frac{1}{2}$*V,a.d,*200% = *two half-V superimposed cuts tapped alternate-daily* (= 2/2*V,a.d.* — *a form of slaughter tapping*)

and $\frac{1}{2}-\frac{1}{2}+\frac{1}{2}-\frac{1}{2}$*V,a.d,*400% = *four half-V cuts* (*two superimposed on each of the two opposite panels*), *tapped alternate-daily* (= 4/2*V,a.d.* — *a more drastic form of slaughter tapping*).

Change-Over Systems

To be indicated by the insertion of special symbols placed *in brackets* immediately after the notation of frequency ; these special symbols to denote the number of alternating panels per cut and the length of the period tapped on each panel (at the stated frequency), in the form shown below :

(2 × 6m) = change-over system with two panels tapped alternatively, each for a six-monthly period at a time.

(3 × 3m) = change-over system with three panels tapped in rotation, each for a three-monthly period at a time.

Examples :

(1) 1/2*S,a.d,*(2x6*m*),100% = *change-over system* : *continuous alternate-daily tapping on a half-spiral cut on the trees, but with tapping periods of six months on each of two alternating panels.*

(2) 1/2*S,a.d,*(2x2*d*),100% = *as* (1) *above, but with tapping periods of only two days (at the stated frequency) on each of the two alternating panels— that is, with alternate tappings on alternate panels.*

(3) 1/3*S,a.d,*(3x6*m*),67% = *change-over system* : *continuous alternate-daily tapping on a third-spiral cut on the trees, but with three panels tapped in rotation, each for a six-monthly period at a time.*

(4) 1/2*S*,*a.d*,(2x2*d*),6/3m,67% = *periodic change-over system* : *alternate-daily periodic tapping on a half-spiral cut on the trees, with periods of six months' tapping and three months' rest and with alternate tappings on alternate panels, as in* (2) *above.*

(5) 1/2*S*,*a.d*,(2x6*m*),6/3*m*,67% = *as* (4) *above on the trees, but with tapping periods of six months on each of the two alternating panels.*

(6) 1/2*S*,*d*,(2x2*w*),2/2*w*,100% = *daily periodic tapping on a half-spiral cut on the trees, with fortnightly periods of tapping and rest, and with alternate tapping periods on alternate panels.*

(7) 2/2*S*,*a.d*,(2x2*d*),200% = *double-cut change-over system* : *continuous alternate-daily tapping on two half-spiral cuts on the trees, but with alternate tappings on two pairs of alternating cuts—that is a system with four cuts on the trees of which only two are tapped at a time, such as is sometimes used in slaughter tapping.*

Note that in each of the above examples the main part of the formula, outside the brackets, is unaffected by the change-over symbols within. The numerator of the initial fraction still denotes the number of cuts tapped on each tree at each tapping, not necessarily the total number of "active" cuts on each tree during any given period. The total number of cuts on the change-over system is indicated by the product of the first number inside the bracket and the numerator of the initial fraction in the formula. Thus in examples (1), (2), (4), (5) and (6) there are two cuts, and in example (3) three cuts, of which only one is tapped at a time, while in example (7) there are four cuts which are tapped in pairs at a time.

Note also that the period given within the bracket is the length of the period *tapped* on each panel *at the stated frequency* and in periodic systems does not necessarily coincide with the interval between changes of panel. Reference to example (6) will make this clear; the change of panel takes place every four weeks, of which two constitute a resting period—hence the system is expressed by (2x2w,) not by (2x4w). But compare example (4) which is written (2x2d), not (2x1d), since with alternate-daily frequency a two-day period denotes a single tapping.

WAR TIME SUPPLY OF COAGULANTS

T. E. H. O'Brien, *Director.*

The Present Position

ON the outbreak of war an apparent shortage of formic and acetic acids developed in the local market and speculators made the most of the situation until maximum prices were fixed by Government. The present controlled prices are as follows :—

	Wholesale	Retail
Formic Acid	Rs. 42.00 ...	Rs. 46.00
Acetic Acid	Rs. 30.50 ...	Rs. 34.00

per carboy of 4 gallons

As far as can be ascertained from import returns local stocks were normal at the time and the rush for supplies must be attributed to the desire of users to safeguard themselves against future shortage. Since the outbreak of war arrivals of acid have been below normal, while requirements have risen owing to the increased export quota. Tapping has been resumed on many smallholdings which had previously been rested for considerable periods, leading to a sudden demand from this class of producer. Users are now finding difficulty in securing supplies, but it is not easy to judge the extent of real shortage. The present position appears to be that there is a severe shortage of supplies among small users, whilst the majority of larger users still have limited reserve stocks.

Prospects of Future Supplies

Imports of acid during the past few years have largely been derived from Germany and the present shortage arises from the sudden stoppage of this source of supply. The prospects of obtaining adequate supplies from other sources under the present circum-

stances are still somewhat indefinite, but the information available up to the present is of a reassuring nature. In reply to enquiries recently addressed to a number of local importers the general opinion was expressed that the shortage was a temporary one and would soon be met from alternative sources. Orders reported to have been already booked for local delivery before the end of January, 1940, represent several months' normal requirements.

The long-term prospects may be influenced by such factors as shipping and exchange difficulties, but it is felt that it will be in the interests of the Local and Imperial authorities to maintain the efficiency of the plantation industry by ensuring that adequate supplies of coagulants are made available. World requirements amount to approximately 4,000 tons of formic acid or 6,000 tons of acetic acid annually.

Economical Use of Coagulants

On the majority of local estates the rubber is rolled on the morning after coagulation, but many smaller producers roll it the same afternoon. The dose of acid can be reduced by approximately one-third if overnight coagulation is practised.

It is usually recommended that the dose of acetic acid should be such that a clear or only slightly cloudy serum remains after coagulation. This is desirable under normal conditions for the following reasons : (1) loss of rubber is prevented, (2) fermentation is less likely to occur, (3) contamination of outlet drains and streams is avoided. Under present circumstances it may be justifiable to eke out supplies of acid by reducing the dosage slightly, but it should be noted that the presence of a milky serum indicates that rubber is being lost.

It has been suggested from Malaya that economy can be effected by re-using a proportion of the serum and tests of this method are being carried out at Dartonfield. In these trials it has been found that moderately good coagulation can usually be obtained when latex (previously diluted to a dry rubber content of $2\frac{1}{4}$ pounds per gallon) is treated with half its bulk of serum from the previous day's coagulation, followed by 2/3 to 3/4 of the normal dose of acid. The completeness of coagulation varies and it seems probable that this arises from day-to-day variations in the composition of

the latex. After re-use of the serum for several days coagulation becomes unsatisfactory owing to the occurrence of putrefaction and a fresh start must be made.

The results at Dartonfield have been less promising than those reported from Malaya and this may indicate that the value of the method will vary according to the character of the latex on different estates. It is suggested that trials should be undertaken on local estates.

Alternative Coagulants

The properties of a good coagulant have been defined as follows by O. de Vries ("Estate Rubber, its preparation, properties and testing," 1920) :—

(1) It must produce a good coherent workable coagulum from which a rubber of good external appearance can be obtained.

(2) It must, under all circumstances which occur on estates, give a good coagulation with either dilute or undiluted latex of varying composition, etc.

(3) The limits within which a good coagulation is obtained must not be too narrow, so that in practice no danger is run of rendering the coagulation incomplete either by using too little or too much of the coagulant.

(4) It must not be detrimental to the (inner) quality of the rubber.

(5) Applied according to the methods of working as they are carried out on estates, and by assistants often with little training, it must produce a rubber which is at least as uniform as that produced by the means now in use.

(6) It must be easy to use even by an untrained personnel and must not be dangerous to handle.

(7) It must be obtainable in large quantities of practically the same composition.

(8) It must be at least as cheap as the media now used.

(9) The total of these properties must give a notable advantage over acetic acid, so that an alteration in methods is profitable enough to overcome the difficulties of arranging a method of work and perhaps of putting a new product on the market.

Many substances are capable of coagulating rubber latex, but it has been established by trial and experience over a number of years that formic and acetic acids are the most suitable materials for the purpose. The use of alternative coagulants should only be adopted as an emergency measure if the normal coagulants are unobtainable.

An increase in the cost of formic and acetic acids should not be regarded as a sound reason for using alternative materials. Even at twice the present controlled prices the cost of coagulation is well under one cent per pound of rubber and the increase is negligible in relation to the improved selling prices now ruling.

Sulphuric Acid.—Rubber manufacturers object to the use of sulphuric acid as a coagulant because the presence of an excess of acid in the rubber, which may easily occur under estate conditions, has an adverse effect on its vulcanising properties. Nevertheless, sulphuric acid can be regarded as a reasonably satisfactory emergency coagulant and it is, in fact, the only alternative material which is likely to be obtainable in adequate quantities at short notice. Ceylon's relatively small requirements (10 tons per week) could probably be met from India or Japan without difficulty.

Sulphuric acid must be used with great caution and the following points should be carefully noted :—

(1) Concentrated sulphuric acid (oil of vitriol) is extremely corrosive and dangerous to handle. Dilution to half strength would probably be desirable before issue to estates and retailers.

(2) The amount used for coagulation must be as small as possible. A slightly cloudy serum should remain after coagulation.

(3) The rubber must be thoroughly washed during milling to remove surplus acid. The latex should be diluted to a dry rubber content not exceeding 1½ lbs. per gallon before coagulation.

(4) Machinery is liable to be damaged by the dilute acid unless thoroughly washed after use.

The dose of sulphuric acid required for coagulation is approximately one fluid ounce of strong acid (S.G. 1.84) to 25 lbs. dry

rubber. The coagulating power is, therefore, approximately similar to that of formic acid on a volume basis, but is lower on a weight basis. The acid should be diluted before use in the proportion of one ounce of acid to one gallon of water. *It is extremely important that dilution should be effected by adding the acid slowly to the water and not by adding the water to the acid.*

Pyroligneous Acid.—When wood or similar material (*e. g.* coconut shells) is heated in a suitable vessel a distillate consisting of dilute acetic acid together with phenolic substances, wood spirit, acetone and tar can be collected. A product of this type was prepared and sold as a coagulant by a local firm during the last war.

The practicability of preparing an improved product from coconut shells at an economic price is now being investigated by the Coconut Research Scheme in conjunction with the Department of Industries. Coagulation trials with redistilled pyroligneous acid undertaken by the Rubber Research Scheme have given satisfactory results and this product is considered suitable for use as an emergency coagulant. It could not be recommended for use under normal conditions without an extensive study of its effects on the properties of the rubber.

Vinegar.—A possibility which will readily occur to producers is the use of vinegar as a coagulant. Natural vinegar is made by a fermentation process and normally contains about 5 per cent. of acetic acid. Some of the material available locally in normal times is probably made artificially by the dilution of commercial acetic acid.

Vinegar is suitable for use as an emergency coagulant but is unlikely to be available in adequate quantities. Ceylon's normal out-turn of vinegar is understood to be approximately 70,000 gallons per annum which would suffice for the coagulation of 3,500 tons of rubber. The quantity required for coagulation is approximately 1 lb. of vinegar to 10 lbs. of dry rubber.

Coconut Water.—The milky fluid which occurs in the coconut ferments on standing and produces an acid liquor which can be used as a coagulant. The maximum acidity, corresponding to about half per cent. acetic acid, develops in 3-4 days, after which a reduction of acidity takes place, probably owing to the occurrence of putrefaction. It is also reported that trouble may arise from

the development of maggots in the fluid if kept too long. It could probably be preserved temporarily by adding sodium bisulphite in the proportion of 1 oz. to 100 gallons a few days after collection.

Fermented coconut water provides a useful coagulant for smallholders and might also be used by larger producers whose properties adjoin Coconut estates. Approximately one "bottle" (1/6 gallon) of the fluid is required to make a 1½ lb. rubber sheet.

Spontaneous coagulation.—If latex is allowed to stand without the addition of a coagulant or preservative fermentation and putrefaction occur and the latex coagulates spontaneously. Coagulation is incomplete and the rubber has an offensive smell. An improved form of spontaneous coagulation results if a small quantity of sugar is added to the latex. The effect of the sugar is to provide an extra source of food for the acid forming organisms; fermentation is encouraged and less putrefaction occurs. The course of the coagulation is also improved if air is excluded by covering the vessel.

Local trials have shown that moderately complete coagulation occurs overnight if sugar is added to the latex at the rate of 1—1½ lbs. to 100 lbs. dry rubber. The sugar should be dissolved in 20 parts of water and the latex should not be diluted, nor should sodium bisulphite be added. This form of coagulation does not produce first grade rubber. Crepe is off-colour owing to the absence of bisulphite and sheet is bubbly. However, the method might be useful in case of a severe shortage of coagulants.

Mineral Salts.—Various salts such as alum, sodium silicofluoride, magnesium sulphate and chloride, sodium acid sulphate, calcium chloride, etc., have been suggested or used as coagulants but they are not likely to be more easily available than the normal coagulants.

Other Coagulants.—Lime juice contains 5—10 per cent. of citric acid and may prove useful as a coagulant for smallholders. The juice of 3—6 limes is required for the coagulation of a rubber sheet weighing 1½ lbs., depending on the ripeness and quantity of juice.

Various other plant juices and extracts are stated to be used by smallholders when normal coagulants are unobtainable or unduly expensive. Goraka (Garcinia Cambogia, Desrouss) when extracted twice by boiling with water was found to have an acid content of approximately 10 per cent. The extract from 1 lb. of semi-dried

fruit would thus suffice for the coagulation of 20 lbs. of rubber. Weera (Hemicyclia sepiaria W. & A.) and Kamaranga (Averrhoa Carambola, L.) also yield acid extracts.

No great objection can be raised to the use of such products in an emergency but efforts would be made to encourage the use of vinegar, coconut water or pyroligneous acid in preference to them in case of a prolonged shortage.

Under the present exceptional conditions it may be necessary as a temporary measure for some producers to vary their normal methods of coagulation. *It is, however, very strongly urged that normal procedure should be resumed at the earliest possible moment with a view to maintaining the Island's reputation for producing good quality plantation rubber.*

Warning

Certain unscrupulous traders are passing off material consisting mainly of sulphuric acid as being pure acetic or formic acid. Coagulants are also being sold under trade names at far higher prices than their coagulating power justifies. Doubtful samples should be forwarded to the Rubber Research Scheme for examination, giving particulars of the source of supply.

LATEX SHIPMENT

M. W. PHILPOTT, *Chemist.*

AS the last communication to this journal on the preservation and shipment of latex was made over three years ago (Research Scheme Quarterly Circular, April, 1936) it seems desirable that the trend and prospects of the latex trade should again be briefly reviewed. In the following notes attention is drawn to recent developments in the technology and utilisation of latex, and factors relevant to the development of a latex export trade in Ceylon are discussed. No attempt is made to deal exhaustively with the subject in any of its aspects.

The Demand for Latex

Latex is shipped chiefly from Malaya and the Netherlands East Indies. Ceylon has undertaken a few small isolated shipments but so far has made no serious attempt to enter the latex market.

The world exports of latex rubber since the year 1928 are shown in Table I. It will be observed that a steady annual increase until 1937 was followed in 1938 by a sharp decline.

TABLE I

	Exports of Latex (Dry Rubber Content)
1928	3,643 tons
1929	5,013 ,,
1930	5,505 ,,
1931	5,817 ,,
1932	8,683 ,,
1933	15,731 ,,
1934	19,505 ,,
1935	20,898 ,,
1936	28,494 ,,
1937	34,516 ,,
1938	22,946 ,,
(1939, first six months	18,934 ,,)

This set-back was roughly parallel to the drop in U.S.A. crude rubber consumption for the same year and appears to have been a reflection of general trade depression. It is to be noted that the returns for the first half of 1939 show a rate of consumption which is higher than the 1937 peak level.

The developing industrial importance of latex is well illustrated by the above table. We do not believe, as did some of the first latex technologists, that latex is destined to replace the older forms of raw rubber, but we recognise it none the less as a raw material of more than temporary value and interest. The close attention which is being given to the technology of latex may be gauged by the fact that Marchionna in his " Latex and Rubber Derivatives and their Industrial Applications," Vol. II, cites well over 2,500 references to patents and papers published during the four years from 1932 to 1936. As far as can be judged from the current publications, moreover, the output of the literature shows no sign of abating.

All this study and investigation can hardly fail to result in an extension of the uses of latex and hence in an increased demand. Nevertheless at the present time it seems probable that the demand during the next year or two will be influenced less by the discovery of new uses than by the development of uses which are already well established. Of such uses it is sufficient to mention the production of latex sponge rubber, a material which is now employed fairly extensively for upholstery and other purposes. Hitherto latex sponge rubber has been manufactured mainly in England where it constitutes the largest individual application for latex within the rubber industry. In U.S.A. where the consumption of latex is about double that of the whole of the rest of the world this important class of manufacture has only recently been taken up. It is understood that several American car manufacturers are proposing to fit their new models with sponge rubber cushions and that one manufacturer has already done so. If development takes place along these lines it may safely be prophesied that the consumption of concentrated latex will soon be substantially increased and that the demand may not at first be easily met.

A point of special interest to Ceylon producers is the growth of the Indian market. Enquiries which have reached the Research

Scheme during the last two years indicate a growing demand for latex, mainly for the manufacture of rubber gloves, balloons and other dipped goods. As far as possible requests for latex have been met by shipments from Dartonfield, but it is already clear that there exists in India a demand which is much larger than it is possible for the Research Scheme to supply.

Standard Grades of Latex

The three chief market grades are :—

(*a*) 38/40 per cent. normal preserved latex.

(*b*) 58/60 per cent. and 60 per cent. concentrated latex.

(*c*) Approximately 68 per cent. evaporated latex.

(*a*) The preparation of normal latex is simple and the cost of equipment is small ; it is estimated that an annual crop of 400,000 lbs. of rubber can be manufactured with plant costing less than Rs. 2,000. But at present the rubber grower is likely to obtain less profit from this type of latex than from the concentrated grades. Details of costs and notes on the method of preparing normal latex for shipment may be found in R.R.S. First Quarterly Circular for 1936, page 15.

(*b*) It is to the preparation of concentrated rather than normal latex that it is particularly desired to draw attention in the present article. The advantage of concentrating latex before shipment becomes immediately evident when a comparison is made between the freight and packing costs for equivalent quantities of 40 per cent. and 60 per cent. latex. Table II shows the approximate relative packing and shipping costs per pound of dry rubber for normal and for 58/60 per cent. concentrated latex. Packing costs are the costs of containers (kerosene tins) and wooden cases (two tins to each case). The items included under shipping costs are :— transport to Colombo (50 miles), freight to London and insurance. In view of recent increases which have taken place in freight and insurance charges and in the price of containers, figures are given on the basis of both the present and pre-war rates.

TABLE II

Packing and Shipping Costs per lb. of Dry Rubber

	38/40% Normal Latex			58/60% Concentrated Latex		
	Packing	Shipping	Total	Packing	Shipping	Total
	Cents	Cents	Cents	Cents	Cents	Cents
At rates current in August, 1939 ...	6·25	9·65	15·9	4·1	6·9	11·0
At rates current in December, 1939	9·0	10·9	19·9	5·85	7·75	13·6

It has been demonstrated in practice that the saving in packing and freight (4·9 cents per lb. before the war, 6·3 cents under present conditions) more than covers the cost of concentration.

In considering the most desirable type of latex for production in Ceylon weight must be given to the trend of the demand for the several grades. Published records on this point are somewhat meagre, but it is perhaps significant that despite the drop in total latex production in 1938 the Malayan exports for concentrated latex for that year were much higher than those of previous years (Table III).

TABLE III

Year	Exports from Malaya of latex with D.R.C. over 5.7 lbs. per gallon
	tons
1935 ...	2,374
1936 ...	3,086
1937 ...	4,774
1938 ...	6,747

Concentration to a D.R.C. of 58 or 60 per cent. is carried out commercially by (*a*) creaming with chemical agents, or (*b*) centrifugation. At present creamed latex is favoured chiefly in U.S.A. and on the Continent while centrifuged latex is used in England, U.S.A. and elsewhere. These preferences are partly governed by patent considerations.

(*c*) Latex may be concentrated to a D.R.C. of 68 per cent. or higher by evaporation after the addition of stabilising agents. This

process is a monopoly of the owners of the "Revertex" patents and need not be considered here.

Market Requirements

As new manufacturing processes are developed the demands of the consumer as regards quality and uniformity become more exacting. London brokers have made it clear that:

(1) It is difficult to dispose of small or non-uniform parcels of latex and the difficulty is likely to increase.

(2) There is a ready market for high quality latex in uniform consignments of not less than 10,000 gallons. This applies to both normal and concentrated latex, but particularly to concentrated.

Preparation

The anticoagulant most commonly employed for preserving latex is ammonia. As soon as possible after the arrival of the latex at the estate factory ammonia gas is added at the rate of 3 to 7 lbs. per 100 gallons depending on the subsequent treatment that the latex is to receive. After ammoniation it is run into bulking tanks from which it is either transferred to the containers for shipment or drawn off for concentration.

In the case of creamed concentrated latex the ammoniated material is mixed with a creaming agent and allowed to stand undisturbed while the rubber globules rise to form a concentrated upper layer. The creaming agent is usually a vegetable mucilage such as tragon seed gum or gum tragacanth; soap is often added to facilitate the creaming process. After 2 to 4 days the lower layer of serum is run off and the upper layer of cream passes to the bulking tank where it is standardised to the correct rubber and ammonia contents. The containers are filled direct from the bulking tank. This process is being regularly worked on a small commercial scale at Dartonfield.

Centrifuged latex is prepared by passing the ammoniated latex through a high speed centrifuge which separates the latex into a rubber-rich fraction and a skim containing a relatively small amount of rubber. The concentrate with a D.R.C. of about 60 per cent. is transferred to the bulking tank to be standardised and is then packed in containers. The skim is generally coagulated

and manufactured into a off-grade crepe. This process is also worked at Dartonfield.

The types of packing used for all grades of latex are (*a*) iron drums holding 40 gallons or more, and (*b*) 4 gallon kerosene tins packed in pairs in wooden cases. Considerable quantities of latex are also shipped in tankers by large producers.

Patents

The commercial production of concentrated latex both by creaming and by centrifugation has been obstructed in the past by patents. In Ceylon the main patents for creaming (Traube, Ceylon Patent 2193, corresponding to B.P. 226,440) and centrifugation (Utermark, Ceylon Patent 2085, corresponding to B.P. 219,635) have recently expired and there is now no restriction on the working of these processes in this country.

To some of the consuming countries where the patents are still in force, concentrated latex can only be shipped under risk of an action for infringement. A glance at Table IV, however, will show that the free market for concentrated latex is not seriously restricted :

TABLE IV

Concentration Process	Consuming Countries in which Use of Concentrated Latex is now free (December, 1939)	Consuming Countries in which Use of Concentrated Latex will be free by end of July, 1940
Creaming (Traube)	Netherlands India	Netherlands India Great Britain France
Centrifugation (Utermark)	Great Britain U.S.A. India	Great Britain U.S.A. India Netherlands

It is important to note that in the United States of America the free use of creamed latex is restricted by a patent which does not expire until 1947. On the whole, therefore, it seems likely that the volume of demand for centrifuged latex will be greater than for creamed. It should be added that there is some doubt

whether either the Traube or the Utermark claims could be upheld if challenged. It is a fact that creamed latex has for some years been imported into Great Britain without action being taken by the patent owners.

Normal (38/40 per cent.) latex is not subject to any patent restrictions.

Cost of Production

Pre-war prices of centrifuges, ammoniating and storage tanks, etc., will be furnished to any producers who may be contemplating the preparation of latex for shipment. Similarly, data on working costs that have been collected in the course of the semi-commercial production at Dartonfield can also be supplied, but in view of the present abnormal conditions it is considered that no useful purpose would be served by publishing details of costs which are liable to undergo large fluctuations from month to month. Such information as the Research Scheme has regarding costs of plant, containers, materials, freight, etc., will be freely given on request.

Premium on Latex

The usual basis for invoicing latex is to charge a definite premium on the buyer's price for smoked sheet prevailing at the time of shipment. For invoicing purposes a gallon of 38/40 per cent. normal latex is reckoned to contain 3·7 lbs. of dry rubber and a gallon of 60 per cent. concentrated latex 5·7 lbs. The price differential varies slightly with the general level of the rubber market; prior to the outbreak of war it was about 1¾d. for normal and 2½d. —2¾d. for concentrated. At present there appears to be a shortage of latex in the home markets and reports have been received that latex is now carrying a premium of as much as 4d. per lb. No doubt this state of affairs will prove to be transitory and the market will become more stable when immediate requirements have been met.

Purified Rubber

Although those competent to judge are of the opinion that the demand for rubber latex has not yet reached saturation point it is obviously impossible to predict with certainty what course the market will take in the future. In the unlikely event of the price differential for latex falling to a level at which production

becomes unprofitable it would be useful to be able to utilise the installation for the manufacture of an alternative grade. Such an alternative grade is purified rubber for which there is a specialised but growing demand. As one of the methods of purification utilises the principle of washing the latex by successive concentration and dilution, a latex concentrating installation could be readily adapted to produce purified rubber.

Special Conditions in Ceylon

The failure of Ceylon producers to take up the manufacture of latex for shipment raises the question whether there are any special local factors which militate against the successful production of latex.

In comparison with Malaya, Ceylon is at a disadvantage in three respects :—

(*a*) The rainfall of Malaya is evenly distributed and causes relatively little interference with tapping. In Ceylon the proportion of days on which latex is diluted with rain water is much higher. Slight dilution is not of great importance, however, if the latex is to be concentrated.

(*b*) For about three months in the year, viz., February (resting period) May and June (heavy rain), the collection of latex for shipment is not practicable. This fact must be taken into consideration in estimating production costs.

(*c*) The estate units are small. For the shipment of large uniform consignments it might be necessary for estates to adopt co-operative measures for bulking. Alternatively the establishment of a central latex factory in Colombo would have to be considered.

Summary

The main considerations for potential latex producers in Ceylon may be summarised as follows :—

(1) The world consumption of latex is increasing and there is evidence of a growing demand in India.

(2) In the British and American markets there is no future for producers who can only supply small or non-uniform consignments. The demand is mainly for uniform shipments of not less

than 10,000 gallons. Small consignments, however, appear to be acceptable in the Indian market.

(3) The manufacture of concentrated latex by creaming or centrifugation is now free from patent restrictions in Ceylon.

(4) There is a free sale for centrifuged latex in the main consuming centres of the world. The sale of creamed latex is at present more restricted but the Indian market is free.

(5) An installation for preserving and concentrating latex could also be used, if desired, for the preparation of purified rubber for which there is a growing demand.

(6) The distribution of rainfall through the year tends to increase the difficulty of preparing latex in Ceylon, but does not constitute a serious obstacle.

MEETINGS, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the adjourned forty-eighth meeting of the Rubber Research Board held in the Committee Room of the Ceylon Chamber of Commerce, Colombo, at 10.30 a.m. on Monday, 3rd July, 1939.

Present: Mr. E. Rodrigo, C.C.S. (in the chair). Messrs. T. Amarasuriya, I. L. Cameron, W. P. H. Dias, J.P., L. B. de Mel, J.P., U.P.M., T. C. A. de Soysa, A. W. Harrison, R. C. Kannangara, M.S.C., J. C. Kelly, L. E. Russell N. D. S. Silva, B. M. Selwyn.

Mr. T. E. H. O'Brien, Director, Mr. R. K. S. Murray, Botanist and Mycologist, and Mr. H. J. Page, Director of the Rubber Research Institute of Malaya, were present by invitation.

Apology for absence was received from Mr. C. H. Collins, C.C.S. (Deputy Financial Secretary).

1. *Discussions with Mr. H. J. Page.*—Mr. H. J. Page, Director, Rubber Research Institute of Malaya, reported on the recent negotiations in London in regard to the co-ordination of the work of the British Rubber Producers' Research Association, the London Advisory Committee for Rubber Research (Ceylon and Malaya) and the Rubber Research Institute of Malaya. A short discussion followed.

The subject of future work on Oidium leaf disease was then discussed and Mr. Page also answered a number of questions on miscellaneous planting topics.

A vote of thanks to Mr. Page for attending the meeting was adopted with applause.

2. *Replacement of Boiler.*—Referring to the decision arrived at at the last meeting to instal a new boiler at a cost of Rs. 1,650 the Chairman reported that it had since been found that the cost would be Rs. 2,200. Agreed that the boiler be purchased and that a supplementary vote be asked for at a later meeting if required.

3. *Examination of Disease Specimens during the absence of the Botanist and Mycologist.*—Decided that the Director of Agriculture be asked to authorise the Government Mycologist to examine disease specimens submitted to the Research Scheme for report during the absence of Mr. R. K. S. Murray on leave.

The meeting terminated with votes of thanks to the chair and to the Chamber of Commerce for the use of the Committee Room.

Research Laboratories,
Dartonfield, Agalawatta.
31st July, 1939.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the forty-eighth meeting of the Rubber Research Board held at Dartonfield Estate, Agalawatta, at 10 a.m. on Wednesday, 21st June, 1939.

Present: Mr. E. Rodrigo, C.C.S. (in the chair), Messrs. T. Amarasuriya, C. H. Collins, C.C.S. (Deputy Financial Secretary), I. L. Cameron, W. P. H. Dias, J.P., L. B. de Mel, J.P., U.P.M., G. E. de Silva, M.S.C., T. C. A. de Soysa, A. W. Harrison, R. C. Kannangara, M.S.C., J. C. Kelly, L. E. Russell, B. M. Selwyn, E. W. Whitelaw.

Mr. T. E. H. O'Brien, Director, was present by invitation.

Apologies for absence were received from Col. T. G. Jayewardene, V.D., Mr. F. A. Obeyesekere, and Mr. E. C. Villiers, M.S.C.

1. Minutes

Minutes of the meeting held on 15th March, 1939, were confirmed and signed by the Chairman.

2. Board

1. The Chairman reported the following changes in the membership of the Board since the last meeting :—

(*a*) Mr. C. A. Pereira had resigned with effect from 7th April, 1939, and Mr. W. P. H. Dias had been nominated in his place from 9th June, 1939.

(*b*) Messrs. T. Amarasuriya and T. C. A. de Soysa had been nominated to represent the Low-country Products Association with effect from 18th May, 1939, in place of Messrs. L. M. M. Dias and J. L. D. Peiris respectively whose periods of membership had expired.

(*c*) Mr. N. D. S. Silva had been nominated to represent the Low-Country Products Association with effect from 26th June, 1939, in place of Col. T. G. Jayewardene whose period of membership expires on that date.

(*d*) Mr. L. E. Russell had been nominated to act for Mr. F. H. Griffith during the latter's absence from the Island with effect from 1st April, 1939.

(*e*) Mr. A. W. Harrison had been nominated to act for Mr. L. P. Gapp during the latter's absence from the Island with effect from 1st April, 1939.

(*f*) Mr. R. C. Kannangara, M.S.C., had been re-nominated for a further period of three years from 26th June, 1939.

A vote of appreciation of the services of the retiring members was recorded and the new members were welcomed to the Board by the Chairman. Referring to Mr. C. A. Pereira the Chairman said that he had been a member of the Board since its inception and had now retired owing to ill-health.

2. *Visit of the Director, Rubber Research Institute of Malaya.*—Reported that Mr. H. J. Page, Director, Rubber Research Institute of Malaya, would be on a visit to the Rubber Research Scheme from July 2nd to July 6th, 1939. Decided to invite Mr. Page to meet the Board on July 3rd, at an adjourned session of the present meeting.

3. Accounts

(*a*) *Statements of Receipts and Payments of the Board for the quarter ended 31st March*, 1939, was approved.

(*b*) *Dartonfield and Nivitigalakele Accounts* for January and February, 1939, were tabled.

(*c*) *Identification of Clones on Estates.*—A statement was presented showing the receipts and payments in connection with the identification of clones on estates by the officers loaned by the Rubber Research Institute of Malaya. Decided that the credit balance of Rs. 643/69 be credited to revenue to cover the overhead charges of the work.

(*d*) *Supplementary Votes.*—The following supplementary votes were approved :—

Salaries of junior scientific staff	Rs. 616
Fire Insurance	Rs. 125

(*e*) *Fixed Deposits.*—Reported that—

(1) A fixed deposit of Rs. 50,000 which matured on 20th March, 1939, had been transferred to current account.

(2) A fixed deposit of Rs. 30,000 had matured on 27th April, 1939. Rs. 15,000 had been re-deposited and the balance had been transferred to current account.

(*f*) *Insurance against Liability for Accidents.*—A memorandum which had previously been circulated to members was considered. Decided to insure against liability in respect of accidents to employees not already covered under the terms of the Workmen's Compensation Ordinance.

4. Staff

(*a*) *Terms of Service for locally recruited Officers.*—Consideration was given to the report of a Committee appointed at the meeting held on 15th March, 1939. The report was accepted subject to minor modifications.

(*b*) *Changes in Junior Staff.*—Reported :—

(1) Resignation of Mr. H. J. Fernando, Budding Instructor, and appointment of Mr. W. F. Fernando in his place.

(2) Appointment of Mr. V. K. Viswanathan as Laboratory Assistant in the Chemical Department.

(*c*) *Rubber Conference Committee.*—Reported the appointment of Messrs. T. E. H. O'Brien and R. K. S. Murray to serve on the Rubber Conference Committee of the Planters' Association of Ceylon.

(*d*) *Rubber Advisory Board.*—Reported the appointment of Mr. T. E. H. O'Brien to act on the Rubber Advisory Board during the absence of Mr. F. H. Griffith from the Island.

(*e*) *Mr. R. K. S. Murray.*—An application from Mr. R. K. S. Murray for three months' sick leave from July 6th was considered and approved. Decided that Mr. Murray should take the opportunity of attending the Imperial Mycological Conference from 18th to 23rd September, 1939.

5. Employment of Daily Paid Non-Ceylonese Labour

Consideration was given to the question whether action should be taken on the same lines as that taken by Government in regard to the employment of non-Ceylonese daily paid labour. After discussion it was agreed that no steps be taken to discharge non-Ceylonese labour but that as many Ceylonese be employed in the future as is practicable. It was noted with appreciation that 50 per cent. of the labour force and 64 per cent. of the tappers at Dartonfield Estate were Ceylonese.

6. London Advisory Committee For Rubber Research (Ceylon and Malaya)

Minutes of meetings of the London Advisory Committee for Rubber Research (Ceylon and Malaya) and the Technical Sub-Committee held on 27th January, 1939, were considered and adopted.

7. Experimental Committee

(*a*) *Membership.*—The following appointments were made :—

Mr. W. P. H. Dias to serve in place of Col. T. G. Jayewardene.

Mr. L. E. Russell to act for Mr. F. H. Griffith.

(*b*) Minutes of a meeting of the Committee held on 6th May, 1939, were considered.

(1) *Bungalow for Geneticist.*—A recommendation to provide a bungalow for the Geneticist was approved and the Director was authorised to make the necessary provision in the estimates for 1940.

(2) *Report of Consulting Engineer.*—The report of the Consulting Engineer was adopted and it was noted that the minor defects mentioned in the report had been adjusted. Decided to purchase a megohmmeter at a cost of Rs. 325.

(3) *Preparation of Concentrated Latex.*—Decided that the sale of concentrated latex be continued in order to acquire further experience of its preparation on a commercial scale and to foster a demand for the product from the Indian market. Agreed that a short memorandum on the preparation of concentrated latex should be published in the Quarterly Circular.

(4) *Oidium Leaf Disease.*—The Chairman stated that recommendations in regard to further work on Oidium Leaf Disease had been made by the Technical Sub-Committee of the London Advisory Committee for Rubber Research (Ceylon and Malaya) at the

meeting held on 27th January, 1939. The proposal had been considered by the Experimental Committee and the discussion by the Experimental Committee and the discussion was fully recorded in the minutes. It had been decided that the question of undertaking a systematic study of the histology of the disease should be left to the Board for consideration.

After a general discussion, in the course of which Mr. R. K. S. Murray, Botanist and Mycologist, placed his views before the meeting, a decision was reached, in principle, in favour of the appointment of a whole-time research officer for work on Oidium. It was, however, noted that recurrent expenditure could not safely be increased while income remained at its present level. It was agreed that the subject should be further discussed with Mr. Page at the adjourned meeting.

(*c*) *Brown Bast Treatment and Yield Recording at Dartonfield.*—Approval was given to proposals for demonstrating methods of brown bast treatment and for recording the yields of individual trees at Dartonfield.

(*d*) *Clone Trials*

(1) The Director was authorised to arrange for the exchange of planting material for experimental purposes with Research Institutes in other countries, subject to any necessary restrictions in regard to re-distribution of the material.

(2) Agreed that budwood from high yielding local estate trees be accepted for trial at Nivitigalakele on the same conditions as those recently approved in connection with the distribution of material of promising clones already under trial.

8. Reports

(*a*) Technical Officers' reports for first quarter, 1939, were considered and adopted.

(*b*) Approval was given for the exchange of progress reports with the British Rubber Producers' Research Association.

9. Smallholdings Department Poster

The design of a poster illustrating the work of the Smallholdings Department was approved and an estimate for printing accepted.

10. Publications

Fourth Quarterly Circular for 1938, first Quarterly Circular for 1939 and Leaflet No. 17 were tabled.

The meeting then adjourned until 10.30 a.m. on July 3rd, 1939.

Research Laboratories,
Dartonfield, Agalawatta.
12th July, 1939.

RUBBER RESEARCH SCHEME (CEYLON).

Minutes of the forty-ninth meeting of the Rubber Research Board held in the Chamber of Commerce Building, Colombo, at 10 a.m. on Thursday, October 12th, 1939.

Present: Mr. E. Rodrigo, C.C.S. (in the chair). Mr. T. Amarasuriya, Mr. C. H. Collins, C.C.S., (Deputy Financial Secretary), Mr. I. L. Cameron, Mr. W. P. H. Dias, J.P., Mr. L. B. de Mel, J.P., U.P.M., Mr. G. E. de Silva, M.S.C., Mr. T. C. A. de Soysa, Mr. A. W. Harrison, Mr. R. C. Kannangara, M.S.C., Mr. J. C. Kelly, Mr. F. A. Obeyesekere, Mr. L. E. Russell, Mr. B. M. Selwyn and Mr. N. D. S. Silva, O.B.E., J.P.

Mr. T. E. H. O'Brien, Director, was present by invitation.

1. Minutes

Minutes of the meeting held on 21st June and of the adjourned meeting held on 3rd July, 1939, were confirmed and signed by the Chairman subject to minor corrections in the record of the statement made by Mr. H. J. Page at the adjourned meeting.

2. Stabilisation of Income from Cess Collections

Reported that a memorandum embodying proposals for stabilisation of the Board's income from cess collections had been forwarded to the Ceylon Estates Proprietary Association, Low-Country Products Association, Planters' Association of Ceylon and the Rubber Growers' Association for consideration, after approval by the Board by circulation of papers. So far replies had been received from two Associations and it was decided to await the other replies before considering the matter further.

3. Smallholdings Committee

Recommendations made at a meeting held on September 23rd, 1939, were considered.

(*a*) *Demonstration Nurseries.*—Decided that budded plants from demonstration nurseries should be sold to smallholders on the same terms as plants budded in the nurseries at Nivitigalakele.

(*b*) *Pamphlet on Dirt in Rubber.*—Decided that a pamphlet suggesting methods for preventing the contamination of rubber with foreign matter should be distributed to all smallholders and that the co-operation of the Rubber Controller should be sought in distributing the pamphlets.

4. Experimental Committee

Recommendations made at meetings held on July 31st, and September 21st, 1939, were considered.

(*a*) *Visiting Agent's Report.*—The Visiting Agent's report on his inspection of Dartonfield and Nivitigalakele Estates on 16th May, 1939, was adopted.

(*b*) *Planting Food Crops.*—The recommendation that an area of three acres at Nivitigalakele should be cleared for use as a Rubber seedling nursery and temporarily utilised for planting food crops was adopted.

(*c*) *Bungalow for Geneticist.*—Agreed that the construction of a bungalow for the Geneticist be postponed in view of the unsettled international situation.

(*d*) *Oidium Leaf Disease.*—It was noted with satisfaction that arrangements had been made for a search for Oidium resistant trees to be conducted on a number of estates in the Matale district during the next refoliation season.

(*e*) *Replanting Experiment in 1941.*—The recommendation to lay down a 5-acre replanting experiment at Dartonfield in 1941 to test certain new clones on a variety of clonal stocks, was approved and it was agreed that heavy tapping on experimental lines should be undertaken in the area in 1940.

(*f*) *Tapping Experiment at Mukalana Estate.*—Approval was given to proposals for a tapping experiment to be undertaken on Mukalana Estate to study the mutual influence of stock and scion, a suitable block of trees budded at a height of 3 ft. being available. The terms of a tapping lease of the area were endorsed and the action of the proprietors of the estate in providing facilities for the experiment was noted with appreciation.

5. Accounts

(*a*) *Statement of Receipts and Payments* of the Board for the quarter ended 30th June, 1939, was adopted.

(*b*) *Dartonfield and Nivitigalakele Accounts* for March, April, May, June and July, 1939, were tabled.

(*c*) *Estimates of Income and Expenditure for 1940.*—Estimates of income and expenditure for 1940 were considered and adopted subject to minor alterations. The following is a summary of the estimates as adopted :—

Income			Rs. 212,975
Expenditure : Revenue Account	Rs. 199,157		
Capital Account	,, 6,722	,,	205,879
Surplus of income over expenditure		Rs.	7,096

6. Staff

(*a*) *Mr. R. K. S. Murray.*—Reported that Mr. R. K. S. Murray, Botanist and Mycologist, had returned from leave on October 9th.

(*b*) *Mr. C. A. de Silva.*—Reported that Mr. C. A. de Silva, Assistant Botanist, had accepted re-engagement for a period of four years from September 9th.

(*c*) *Officers on Military Service.*—Reported that Mr. M. W. Philpott, Chemist, and Dr. C. E. Ford, Geneticist, had been mobilised with the Ceylon Defence Force during September. It was agreed that the rules regarding the payment of salaries to Government officers serving with mobilised units of the Defence Force should also apply to Research Scheme officers.

7. Technical Officers' Progress Reports for the Quarter Ended 30th June, 1939, were adopted.

8. Co-operation with British Rubber Producers' Research Association

A letter was read from the Director of the British Rubber Producers' Research Association offering the close co-operation of his Association. The policy of reciprocal co-operation was cordially approved.

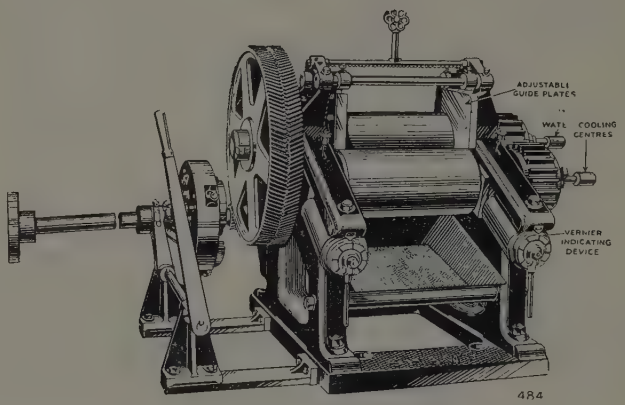
9. Issue of Publications to Holders of Permits for New Planting

Arising from the application of a holder of a permit for new planting to be registered for free issue of Research Scheme publications it was agreed that publications should be supplied without charge to applicants who were planting areas exceeding ten acres.

The meeting terminated with a vote of thanks to the Chamber of Commerce for the use of the Committee Room.

Research Laboratories,
Dartonfield, Agalawatta,
14th November, 1939.

Shaws
Rubber Mills



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London Advisory Committee for Rubber Research (Ceylon and Malaya).

Member nominated by the Colonial Advisory Council of Agriculture and Animal Health:

Sir Frank Stockdale, K.C.M.G., C.B.E.

Member nominated by the Government of Ceylon:

Dr. W. Youngman, D.Sc., Ph.D.

Member nominated by the Governments in British Malaya:

Mr. J. Lornie, C.M.G.

Members representing Malayan Planting interests—nominated by the Rubber Growers' Association:

Mr. P. J. Burgess (Chairman).

Mr. J. L. Milne.

Mr. Eric Macfadyen.

Members representing Ceylon Planting interests—nominated by the Rubber Growers' Association:

Sir Herbert Wright.

Mr. G. H. Masefield.

Mr. George Brown.

Member representing Manufacturing interests:

Lieutenant-Colonel J. Sealy-Clarke.

Ex-Officio Members:

Sir H. A. F. Lindsay, K.C.I.E., C.B.E., Director of the Imperial Institute.

Professor V. H. Blackman, Director of the Botanical Laboratories, Imperial College of Science and Technology.

Mr. S. F. Ashby, Director of the Imperial Mycological Institute.

Sir John Russell, O.B.E., Director of the Rothamsted Experimental Station.

Secretary:

Mr. J. A. Nelson, B.Sc.

The Technical Sub-Committee consists of members of the Advisory Committee with the following co-opted Members:

Mr. G. Martin (Superintendent of Rubber Investigations).

Mr. G. E. Coombs.

Mr. G. G. Balazs.

Mr. B. D. Porritt.

Mr. H. N. Ridley

Mr. W. C. Smith

Dr. H. P. Stevens

Dr. D. F. Twiss

Prof. R. G. H. Clements

STAFF.

Mr. G. Martin, B.Sc., A.I.C., F.I.R.I.

Mr. H. C. Baker, M.Sc., A.I.C., A.I.R.I.

RUBBER RESEARCH SCHEME (CEYLON)

LIST OF PUBLICATIONS FOR SALE

Bulletins No. 1-20. Bound volume, Rs. 5.00. Later Bulletins Re. 1.00 per copy.

No. 1. The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis*.
No. 2 The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis*.
No. 3. Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis*, Part I.
No. 4. The Physiological Effects of Various Tapping Systems, Part I.
No. 5. Progress Report on Vulcanization Tests.
No. 6. The Physiological Effects of Various Tapping Systems, Part II.
No. 7. The Physiological Effects of Various Tapping Systems, Part III.
No. 8. Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis*, Part II.
No. 9. Vulcanization Tests.
No. 10. Vulcanization Tests.
No. 11. Variability in Rubber Manufacture.
No. 12. Progress Report of the Rubber Research Chemist.
No. 13. Vulcanization Tests.
No. 14. On the Variation in the Number of Latex Vessels present in *Hevea Braziliensis*.
No. 15. Vulcanization Tests.
No. 16. On the Natural Clotting of Rubber Latex
No. 17. Vulcanization Tests.
No. 18. Measurements of "Bark Renewal"
No. 19. Vulcanization Tests.
No. 20. Vulcanization Tests.
No. 21. Vulcanization Tests. 1919
No. 22. Vulcanization Tests. 1919
No. 23. Vulcanization Tests. 1920
No. 24 Vulcanization Tests. 1920
No. 25. Investigations on Samples of Plantation Para Rubber from Ceylon. 1921
No. 26. Results of Trials of Ceylon Plantation Rubber for the Manufacture of Ebonite 1921
No. 27. Investigation on Samples of Plantation Para Rubber from Ceylon. 1921
No. 28. Investigations on Samples of Plantation Para Rubber from Ceylon. 1922
No. 29. Summary of the Principal Results Obtained from Investigations into the Properties of Ceylon Plantation Rubber in Relation to its Method of Preparation. 1922
No. 30. The Penetration of Disinfectant on the Tapping Cut of *Hevea Braziliensis*. 1922
No. 31. On the Occurrence "of Rust" on Sheet Rubber. 1923
No. 32. On the Preservation of Latex. 1924
No. 33. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 34. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 35. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 36. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 37. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 38. Investigations on Samples of Plantation Para Rubber from Ceylon. 1925
No. 39. Do. (Final Report Series 1) 1925
No. 40. Do. Series II 1926
No. 41. Do. First Interim Report on Artificial Ageing Tests. 1926
No. 42. On the Smoking of Sheet Rubber in Relation to Mould Prevention. 1926
No. 43. The Inter-Relationship of Yield and the Various Vegetative Characters in *Hevea Braziliensis* (out of print). 1926
No. 44. The Construction of Smokehouses for Small Rubber Estates (out of date). 1926
No. 45. The Efficiency of Disinfectants and Fungicides. 1927
No. 46. The Control of Bark Rot by Disinfectants. 1927
No. 47. Report on Variability of Ceylon Estate Grades. 1927
No. 48. Brown Bast and its Treatment. 1928
No. 49. Report on Causes of Variation in Plasticity. 1928
No. 50. Crepe Rolling. 1929
No. 51. The Curing of Sheet Rubber. 1930
No. 52. The Preparation of Uniform Rubber. 1932
No. 53. Oidium Leaf Disease. 1936
No. 54. Report on a Visit to Malaya, Java and Sumatra. 1937

Booklets at Rs. 2.50 per copy.

Guide to the Preparation of Plantation Rubber, by T. E. H. O'Brien, M.Sc., A.I.C., Chemist.

The Budding of Rubber, by R. A. Taylor, B.Sc., Physiological Botanist (out of date)
Diseases of Rubber in Ceylon by R. K. S. Murray, A.R.C.Sc., Mycologist.

Copies of the following publications of the Rubber Research Institute of Malaya are available at the prices indicated :—

Planting Manual No. 4—Latex Preservation and Shipment. Rs. 3.50

Printed by The Times of Ceylon Co., Ltd., Colombo.